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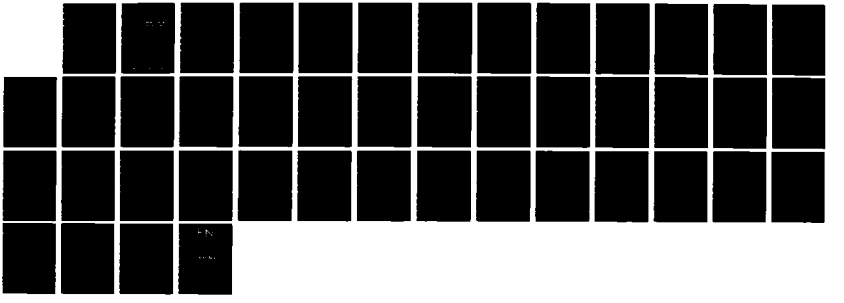

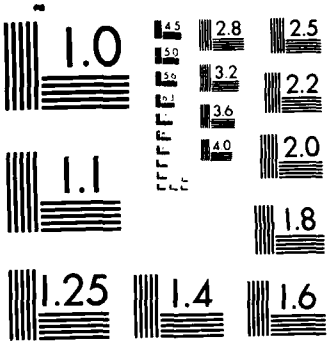

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CRC Report No. 545

OCTANE REQUIREMENT INCREASE OF 1983 MODEL CARS

November 1985

COORDINATING RESEARCH COUNCIL, INC.
219 PERIMETER CENTER PARKWAY, ATLANTA, GEORGIA 30346

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OCTANE REQUIREMENT INCREASE OF 1983 MODEL CARS

(CRC PROJECT No. CM-124-83)

Prepared by the

1983 Octane Requirement Increase Analysis Panel

of the

CRC-Automotive Octane Technology and Test Procedures Group

November 1985

Automotive Vehicle Fuel, Lubricant, and Equipment Research Committee

of the

Coordinating Research Council, Inc.

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I. SUMMARY

- Octane requirement increase (ORI) was determined for seventy-nine 1983 model cars operated on unleaded gasoline. The cars tested were not selected to represent the distribution of vehicles produced in the model year; rather the data base consists of information volunteered by participants. All ORI values were determined from the increase in maximum octane requirements irrespective of whether requirements were obtained at full- or part-throttle. Though the sample size is smaller than in previous years, it does not appear to have significantly affected the conclusions.

- At 15,000 miles, the mean ORI for all cars with full-boiling range unleaded (FBRU) fuels was 4.4 Research octane numbers, 2.9 Motor octane numbers, and 3.7 (R+M)/2 numbers.

- At 15,000 miles, the mean ORI with full-boiling range unleaded (FBRU) fuels for the sixty car subset tested on all three reference fuels was 4.4 Research octane numbers, 2.7 Motor octane numbers, and 3.6 (R+M)/2 numbers.

- At 15,000 miles, the mean ORI for sixty cars with full-boiling range high sensitivity unleaded (FBRSU) fuels was 4.7 Research octane numbers, 3.3 Motor octane numbers, and 4.0 (R+M)/2 numbers.

- At 15,000 miles, the mean ORI for sixty cars with primary reference (PR) fuels was 3.9 octane numbers.

- Compared with 1982 models (115 cars), the mean ORI for all cars in the 1983 program with FBRU fuels decreased 0.5 RON, 0.1 MON, and 0.2 (R+M)/2.

- In general, the mean ORI (unweighted) with FBRU fuel exhibits a slight downward trend for the 1975 through 1983 model cars.

- ORI decreases about 0.1 to 0.2 octane number per octane number increase of initial octane requirements, but this relationship is no longer statistically significant.

II. INTRODUCTION

The need to study octane requirement increase (ORI) with unleaded fuel became evident in 1970 when manufacturers announced that future cars would use unleaded gasoline of at least 91 RON quality, and that they would require catalytic converters to meet emission standards in 1975 models. The Coordinating Research Council, Inc. (CRC) initiated a series of ORI programs in 1971 to study the effect of these changes. Since that time, manufacturers have made many engine and car modifications to meet both exhaust emission and fuel economy standards. Because of continuing engineering changes and the now exclusive use of unleaded fuel, the ORI programs have been continued.

The ORI data from 1971 and 1973 through 1982 model cars have been reported previously.[1-10] This report will summarize ORI data for 1983 model cars.

III. EXPERIMENTAL

A. Cars Tested

In the 1983 program, sixty-eight US and eleven imported cars were used to determine the ORI of 1983 model cars. Cars tested were not selected to represent the distribution of vehicles produced in that model year; rather the data base consists of information volunteered by participants. Data on cars that did not complete 15,000 miles of testing were excluded from the analysis. Participating laboratories are listed in Appendix A.

B. Mileage Accumulation

Mileage accumulation was conducted from the fall of 1982 through the summer of 1984. All test cars were operated in customer-type service using unleaded fuels typical of commercially available gasoline. No attempt was made to separate the data so that laboratory-to-laboratory effects could be determined.

C. Unleaded Average Sensitivity Full-Boiling Range Reference Fuel (FBRU)

In general, octane number requirements of 1983 model cars were defined initially with 1982 FBRU fuel. As mileage increased, the reference fuel was replaced with the 1983 FBRU fuel. Laboratory X used a third FBRU reference fuel series for all octane requirements it submitted. The RON-to-MON conversions used in the data analysis for 1983 cars are shown in Appendix C, Table C-I.

D. High Sensitivity Unleaded Full-Boiling Range Reference Fuel (FBRSU)

Octane requirements of sixty cars were defined initially with 1982 FBRSU fuel and later with 1983 FBRSU fuel as well as with FBRU and Primary Reference (PR) fuels. The RON-to-MON conversions used in data analysis are shown in Appendix C, Table C-II.

E. Primary Reference (PR) Fuel

Standard ASTM PR fuel was used in two octane number increments from 76 to 82, and in one octane number increments from 82 to 100, to cover the range of car requirements.

F. Test Technique

Octane number requirements were determined at incremental mileages from zero to 15,000 miles by the CRC E-15-83 technique.[11] Maximum octane number requirements were determined on seventy-nine cars with FBRU fuel and sixty cars with both FBRSU and PR fuels.

IV. DISCUSSION OF RESULTS

A. Data Analysis Technique

For this program, octane requirements were to be obtained at 0, 5,000, 10,000, and 15,000 miles; however, not all the data were obtained exactly at these mileage intervals. To compare the ORI of all cars at the same mileage, results were determined from best-fit curves of actual reported octane requirements. Research octane number requirements (RON) reported by the participants were plotted at the mileages at which they were obtained. Requirements at 0, 5,000, 10,000, and 15,000 miles were then read from best-fit curves as shown in Figure 1. ORI at 5,000, 10,000, and 15,000 miles were determined from these best-fit-curve requirements.

ORI on a Motor octane number (MON) basis was determined from best-fit-curve RON requirements that were translated into MON requirements according to the RON-to-MON conversions in Tables C-I and C-II. Similarly, ORI on an (R+M)/2 basis was determined from (R+M)/2 requirements that were calculated from best-fit-curve RON and corresponding MON values. The appropriate RON-to-MON conversion was determined by the fuel series used to determine the actual reported requirement that was closest to the 0-, 5,000-, 10,000-, or 15,000-mile intervals. In general, requirements were determined initially on 1982 fuels and later on 1983 fuels. Laboratory X used a third FBRU reference fuel series; all data reported by this laboratory were translated according to the Laboratory X RON-to-MON conversion in Table C-I.

Best-fit-curve octane requirements at 0, 5,000, 10,000, and 15,000 miles are listed for each car in Appendix D, Tables D-I, D-II, and D-III for FBRU, FBRSU, and PR fuels, respectively. Copies of raw octane requirement data and best-fit curves are on file with CRC.

Distribution of initial RON, MON, and (R+M)/2 requirements, as well as ORI values for each mileage interval, are summarized in Tables I, II, and III for FBRU, FBRSU, and PR fuels, respectively. The numbers in parenthesis in Table I are the average FBRU and PR ORI values of the sixty cars for which data on all three reference fuels were reported. These tables also include a breakout by manufacturer and engine type where sufficient samples exist.

Distributions of initial RON requirements are plotted in Figure 2 for all three fuel series. Distributions of ORI at various mileages for RON, MON, and (R+M)/2 on FBRU fuels are shown in Figures 3, 4, and 5, respectively, and on FBRSU fuels in Figures 6, 7, and 8. Similarly, distribution of ORI on PR fuels at various mileages are shown in Figure 9.

Because some laboratories tested cars on two different reference fuel series, the MON ORI may be different from that determined from a single reference fuel series. The difference in sensitivity (RON minus MON) ranges from 0.0 to 1.0 and 0.0 to 0.3 for the three FBRU and two FBRSU fuel series, respectively. Although an estimate of the error cannot be made from these data, work by other researchers suggest it may be as much as 0.5 MON.[12]

Members of the Analysis Panel are listed in Appendix B.

B. Comparison of 1975 through 1983 ORI Studies

The mean ORI values for 1975 through 1983 model cars are:

Model Year	Accumulated Miles	Mean ORI FBRU, RON	Mean ORI PRF
1975	16,000	5.8	4.4
1976	15,000	5.4	3.6
1977	15,000	4.9	2.9
1978	15,000	6.0	4.2
1979	15,000	5.4	4.1
1980	15,000	5.1	3.9
1981	15,000	5.1	4.1
1982	15,000	4.9	4.0
1983	15,000	4.4	3.9
1975-1983 Unweighted Average:		5.2	3.9

ORI with FBRU fuel continues a slight downward trend from 1975 and is illustrated on Figure 10. ORI with PR fuel is unchanged over this period.

C. ORI Versus Initial Octane Requirements

Initial RON requirements are plotted against ORI at 15,000 miles in Figures 11, 12, and 13 for FBRU, FBRSU, and PR fuels, respectively. The trend between initial requirements and ORI was determined by linear least squares regression analysis. The general form of the equation was:

$$ORI = a + b\ (\text{Initial Octane Requirement})$$

The best-fit lines are also shown in Figures 11, 12, and 13.

Equations for the three reference fuel series are:

Reference Fuel Series	a		b		R^2
	Estimate	Value of Estimate	Estimate	Value of Estimate	
FBRU	16.6	2.4	-0.14	-1.8	0.04
FBRSU	15.5	1.8	-0.12	-1.3	0.03
PR	21.2	3.4	-0.20	-2.7	0.12

In general, ORI decreases about 0.1 to 0.2 units per unit increase of initial requirements. The correlation coefficients (R^2) are small, but in the past, the analysis has indicated that the estimates of the slope (ORI/Initial Requirement) are statistically significant.[8,9,10] This relationship, however, is not statistically significant for the 1983 model cars.

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REFERENCES

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TABLES

AND

FIGURES

TABLE I

INITIAL OCTANE NUMBER REQUIREMENTS AND ORI AT VARIOUS MILEAGES -- FBRU FUEL

		RON								MON								(R+M)/2							
		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI	
Group	No. of Cars Tested	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
All Cars	79	87.1	3.7	3.1	2.1	4.1	2.5	4.4	2.6	80.8	2.4	2.0	1.4	2.6	1.6	2.9	1.7	84.0	3.0	2.6	1.7	3.4	2.0	3.7	2.1
	(60)	(86.7)	(3.8)	(3.1)	(2.2)	(4.1)	(2.6)	(4.4)	(2.8)	(80.7)	(2.5)	(1.9)	(1.4)	(2.5)	(1.6)	(2.7)	(1.7)	(83.7)	(3.1)	(2.5)	(1.8)	(3.3)	(2.1)	(3.6)	(2.2)
All Make A	49	87.8	3.4	3.3	2.1	4.4	2.4	4.7	2.5	81.3	2.2	2.1	1.4	2.8	1.6	3.1	1.6	84.5	2.7	2.7	1.7	3.6	2.0	3.9	2.1
	(30)	(87.5)	(3.6)	(3.3)	(2.4)	(4.4)	(2.8)	(4.7)	(2.8)	(81.3)	(2.2)	(2.0)	(1.5)	(2.7)	(1.7)	(2.9)	(1.8)	(84.4)	(2.9)	(2.7)	(2.0)	(3.6)	(2.3)	(3.8)	(2.3)
All Make B	11	87.6	3.5	2.7	2.1	3.5	2.6	3.9	2.7	81.3	2.2	1.6	1.3	2.1	1.6	2.4	1.7	84.4	2.8	2.1	1.7	2.8	2.1	3.1	2.2
All Make C	3	89.3	3.2	1.8	2.7	2.0	2.7	2.0	2.6	82.3	1.6	1.3	2.0	1.4	2.0	1.4	2.0	85.8	2.4	1.6	2.3	1.7	2.3	1.7	2.3
All Make D	5	84.4	1.5	3.4	1.2	4.8	2.1	5.6	2.7	79.4	1.1	2.1	0.7	2.9	1.0	3.3	1.4	81.9	1.3	2.7	1.0	3.8	1.5	4.5	2.0
All Others E	11	83.9	4.1	3.1	2.2	3.8	2.5	4.0	2.5	78.8	3.0	2.1	1.6	2.4	1.6	2.6	1.6	81.3	3.5	2.6	1.5	3.1	2.0	3.3	2.0
Engine A18	7	84.7	3.3	3.7	2.0	4.7	2.2	5.2	2.4	78.9	2.3	2.6	1.5	3.3	1.6	3.7	1.6	81.8	2.8	3.2	1.7	4.0	1.9	4.4	2.0
Engine A20	10	91.2	2.2	2.7	1.1	3.8	1.6	4.3	1.8	83.4	1.4	1.7	0.7	2.6	1.0	2.9	1.2	87.3	1.8	2.2	0.9	3.2	1.3	3.6	1.5
	(6)	(91.3)	(2.3)	(2.8)	(1.1)	(4.2)	(1.5)	(4.8)	(1.8)	(83.5)	(1.3)	(1.6)	(0.6)	(2.6)	(0.9)	(3.0)	(1.1)	(87.4)	(1.8)	(2.2)	(0.8)	(3.4)	(1.2)	(3.9)	(1.4)
Engine A28	5	88.0	1.6	4.0	3.4	4.9	3.8	5.2	3.9	81.3	1.1	2.5	2.0	3.1	2.3	3.4	2.5	84.7	1.3	3.2	2.7	4.0	3.1	4.3	3.2
Engine A30	9	86.4	1.9	2.6	1.4	3.6	1.5	4.1	1.8	80.5	1.1	1.7	1.0	2.3	1.1	2.6	1.2	83.5	1.5	2.1	1.2	3.0	1.3	3.3	1.5
	(5)	(85.6)	(1.5)	(2.1)	(0.6)	(3.2)	(1.4)	(3.7)	(1.9)	(80.2)	(0.9)	(1.2)	(0.4)	(1.8)	(0.7)	(2.1)	(1.0)	(82.9)	(1.2)	(1.7)	(0.5)	(2.5)	(1.0)	(3.0)	(1.4)
Engine A38	5	85.8	4.1	5.2	2.8	6.3	2.6	6.5	2.4	80.0	2.4	3.5	1.8	4.1	1.6	4.3	1.4	82.9	3.2	4.3	2.3	5.2	2.0	5.4	1.9
Engine B38	5	88.8	3.6	1.6	1.6	2.0	1.7	2.2	1.8	82.2	2.1	0.9	0.9	1.2	1.0	1.3	1.1	85.5	2.9	1.3	1.2	1.6	1.3	1.8	1.5
Engine D14	5	84.4	1.5	3.4	1.2	4.8	2.1	5.6	2.7	79.4	1.1	2.1	0.7	2.9	1.0	3.3	1.4	81.9	1.3	2.7	1.0	3.9	1.5	4.5	2.0

( ) Numbers in parentheses represent FBRU data on cars that were also tested on FBR5U and PR Fuels.

TABLE II

INITIAL OCTANE NUMBER REQUIREMENTS AND ORI AT VARIOUS MILEAGES -- FBKSU FUEL

		RON								MON								(R+M)/2							
		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI		Initial Requirements		5,000-Mile ORI		10,000-Mile ORI		15,000-Mile ORI	
Group	No. of Cars Tested	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
All Cars	60	87.7	3.7	3.3	2.3	4.3	2.6	4.7	2.7	78.9	2.7	2.4	1.6	3.0	1.8	3.3	1.9	83.3	3.2	2.8	1.9	3.7	2.2	4.0	2.3
All Make A	30	88.7	3.6	3.5	2.4	4.5	2.8	4.9	2.9	79.7	2.6	2.4	1.7	3.1	2.0	3.4	2.0	84.2	3.1	2.9	2.1	3.8	2.4	4.1	2.4
All Make B	11	87.9	3.6	3.0	2.6	4.0	2.8	4.4	2.9	79.1	2.6	2.2	1.9	2.8	2.0	3.1	2.0	83.5	3.1	2.6	2.2	3.4	2.4	3.7	2.5
All Make C	3	91.0	3.5	2.2	2.4	3.0	3.1	3.3	3.2	81.2	2.3	1.7	1.7	2.3	2.2	2.4	2.2	86.1	2.9	2.0	2.1	2.6	2.6	2.9	2.7
All Make D	5	85.4	0.9	4.3	0.9	5.9	1.4	6.5	2.1	77.2	0.7	3.2	0.6	4.2	0.9	4.6	1.3	81.3	0.8	3.7	0.7	5.0	1.2	5.6	1.7
All Others E	11	84.9	3.3	3.1	2.0	3.8	2.2	4.0	2.2	76.8	2.4	2.3	1.4	2.8	1.6	3.0	1.6	80.9	2.8	2.7	1.7	3.3	1.9	3.5	1.9
Engine A20	6	92.7	2.2	2.9	1.1	4.5	2.0	5.2	2.5	82.5	1.4	1.9	0.7	3.0	1.3	3.5	1.8	87.6	1.8	2.4	0.9	3.7	1.7	4.4	2.2
Engine A30	5	87.0	1.7	2.2	1.6	3.2	1.9	3.5	2.2	78.5	1.3	1.5	1.2	2.3	1.5	2.5	1.6	82.7	1.5	1.8	1.4	2.7	1.7	3.0	1.9
Engine B38	5	89.4	4.0	1.8	1.6	2.3	1.8	2.5	2.0	80.1	2.8	1.2	1.1	1.7	1.4	1.9	1.5	84.8	3.4	1.5	1.4	2.0	1.6	2.2	1.7
Engine D14	5	85.4	0.9	4.3	0.9	5.9	1.4	6.5	2.1	77.2	0.7	3.2	0.6	4.2	0.9	4.6	1.3	81.3	0.8	3.7	0.7	5.0	1.2	5.6	1.7

TABLE III

INITIAL OCTANE NUMBER REQUIREMENTS AND ORI AT VARIOUS MILEAGES -- PR FUELS

Group	No. of Cars Tested	Initial Requirements Mean	Initial Requirements SD	5,000-Mile ORI Mean	5,000-Mile ORI SD	10,000-Mile ORI Mean	10,000-Mile ORI SD	15,000-Mile ORI Mean	15,000-Mile ORI SD
All Cars	60	85.4	4.0	2.8	1.9	3.6	2.2	3.9	2.4
All Make A	30	86.2	4.0	2.8	1.9	3.6	2.4	3.9	2.4
All Make B	11	86.6	3.0	2.3	2.0	3.1	2.0	3.4	2.1
All Make C	3	85.3	3.2	2.6	0.5	3.4	0.7	3.6	1.0
All Make D	5	84.0	1.6	3.2	1.7	4.6	2.4	5.3	3.0
All Others E	11	82.6	4.6	3.3	2.3	3.8	2.6	4.0	2.6
Engine A20	6	89.2	1.5	2.8	0.5	4.0	0.9	4.4	1.3
Engine A30	5	85.2	1.8	1.5	0.9	2.1	1.2	2.4	1.4
Engine B38	5	87.6	3.2	1.2	0.7	2.0	1.3	2.2	1.4
Engine D14	5	84.0	1.6	3.2	1.7	4.6	2.4	5.3	3.0

FIGURE 1

BEST-FIT-CURVE ORI ANALYSIS

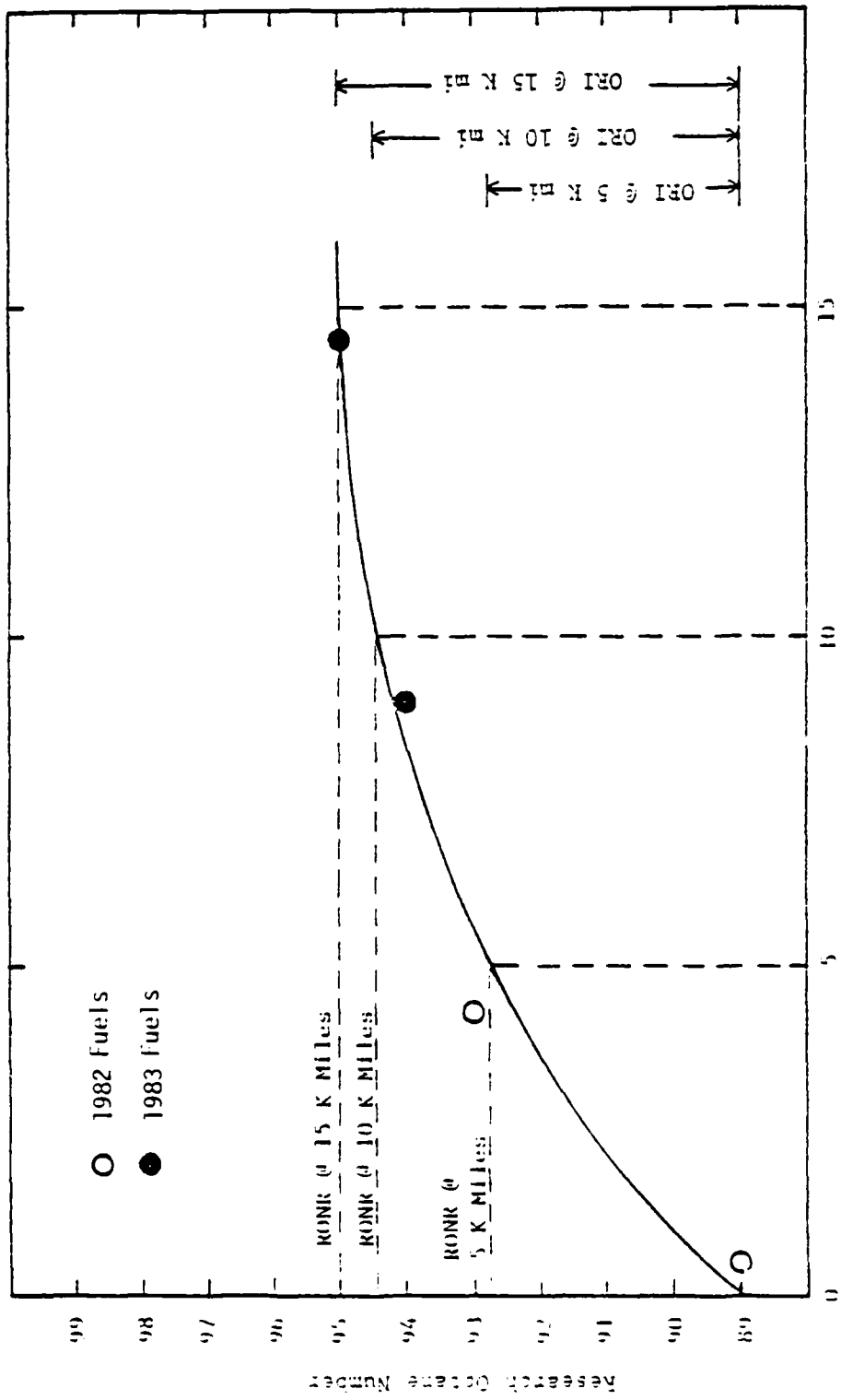


FIGURE 2

DISTRIBUTION OF INITIAL RON REQUIREMENTS

FOR 1983 MODEL CARS

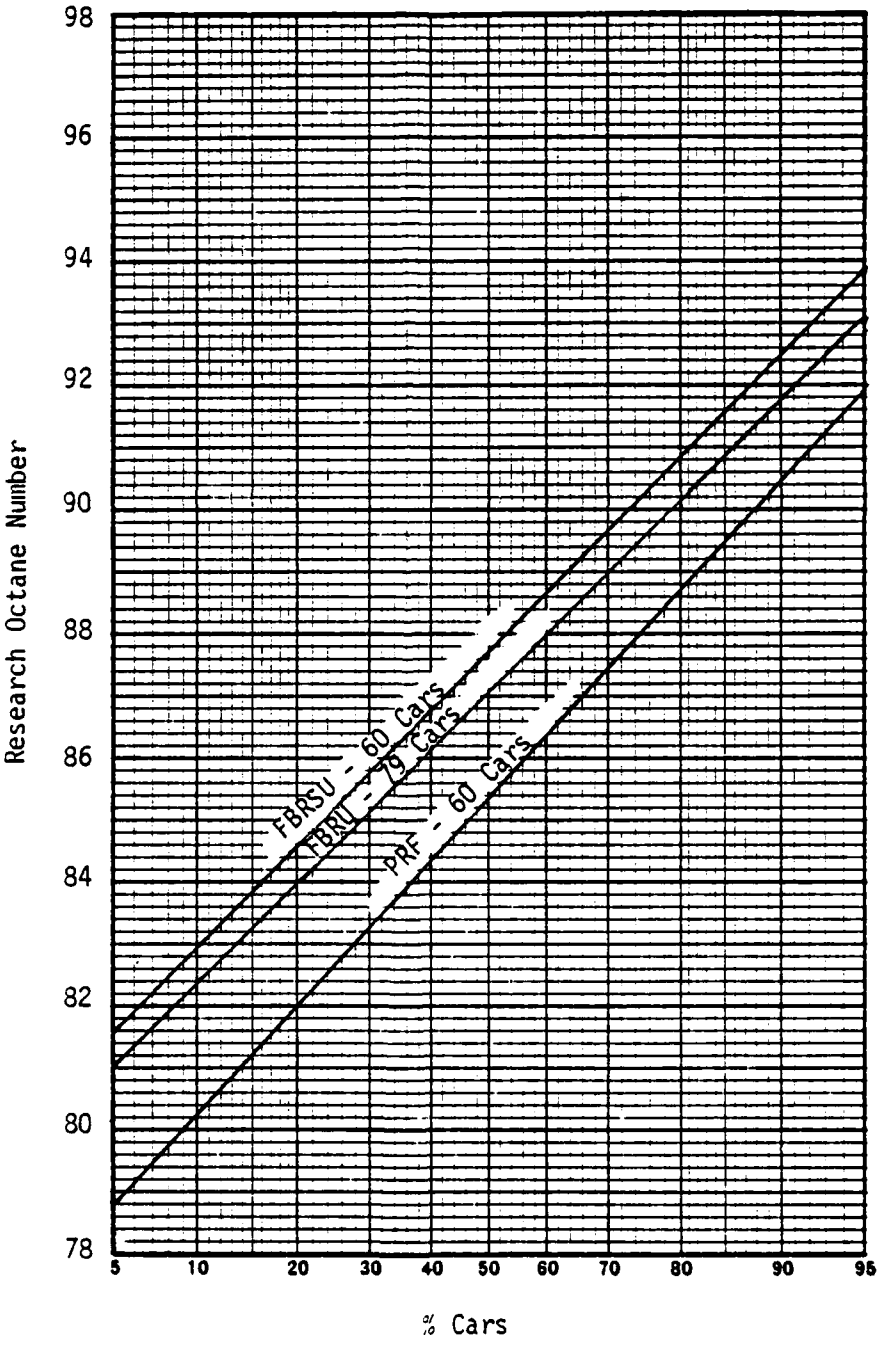


FIGURE 3

DISTRIBUTION OF RON ORI FOR
79 1983 MODEL CARS AT
VARIOUS MILEAGES ON FBRU FUEL

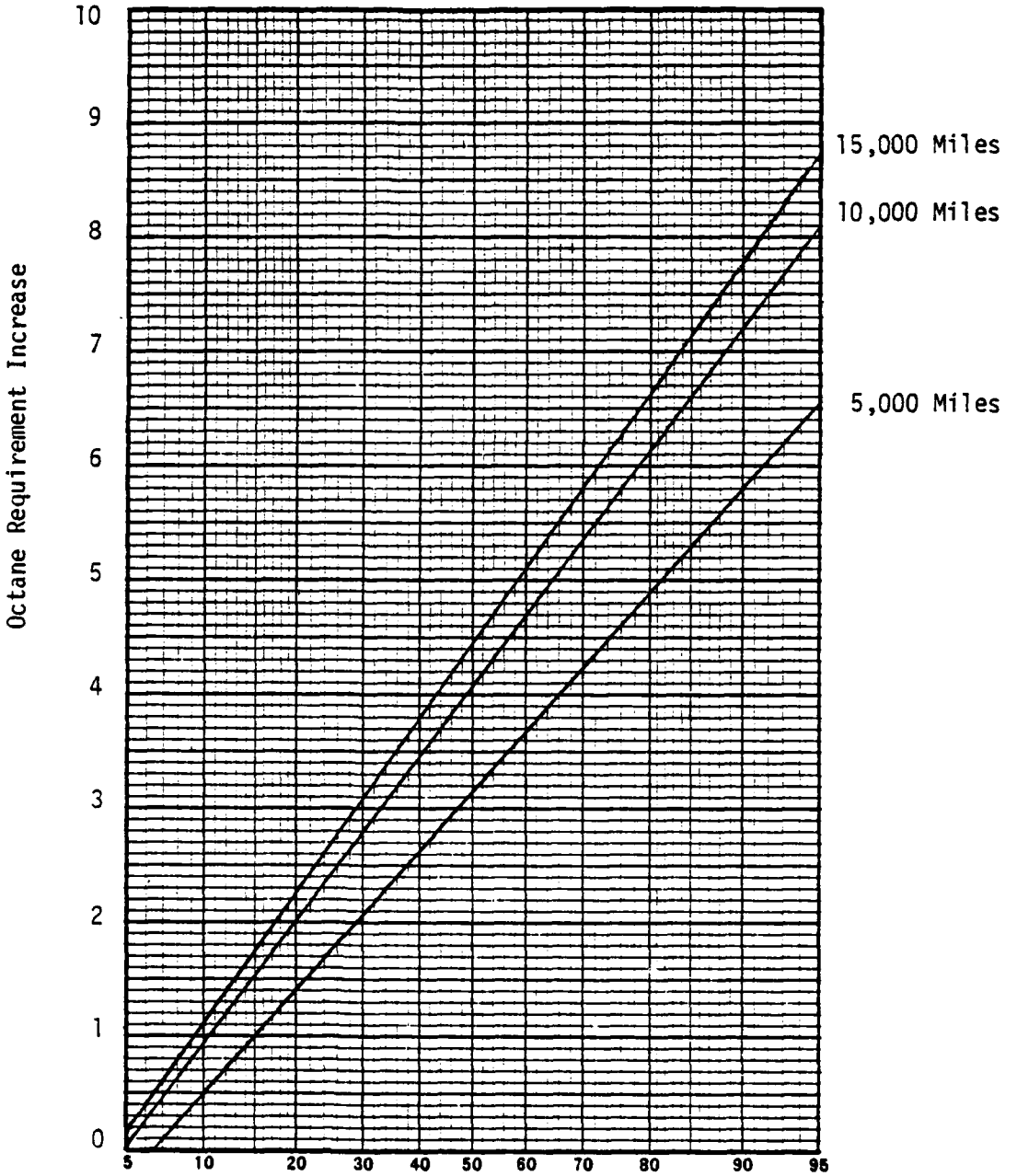


FIGURE 4

DISTRIBUTION OF MON ORI FOR
79 1983 MODEL CARS
AT VARIOUS MILEAGES ON FBRU FUEL

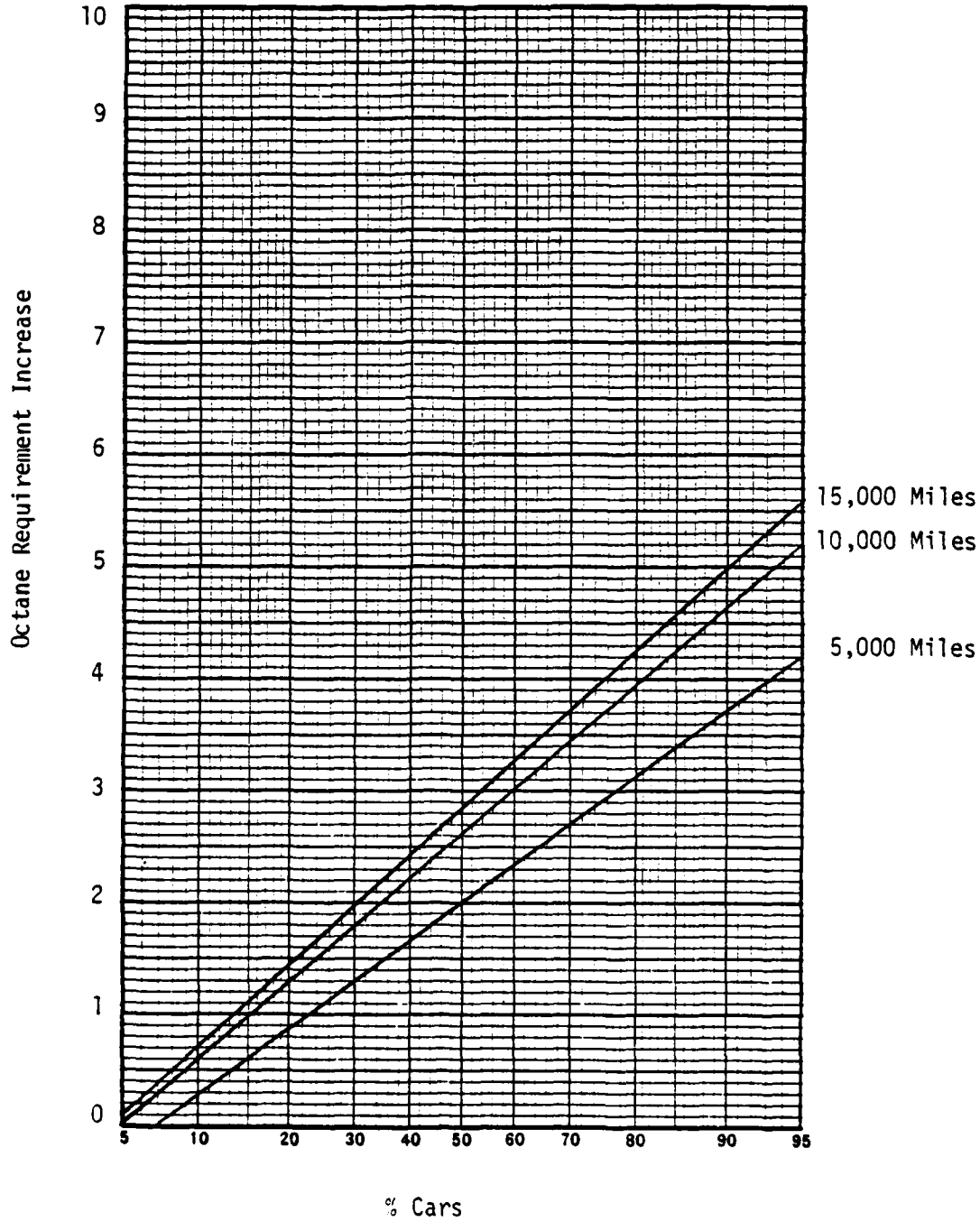


FIGURE 5

DISTRIBUTION OF (R+M)/2 ORI FOR
79 1983 MODEL CARS AT
VARIOUS MILEAGES ON FBRU FUEL

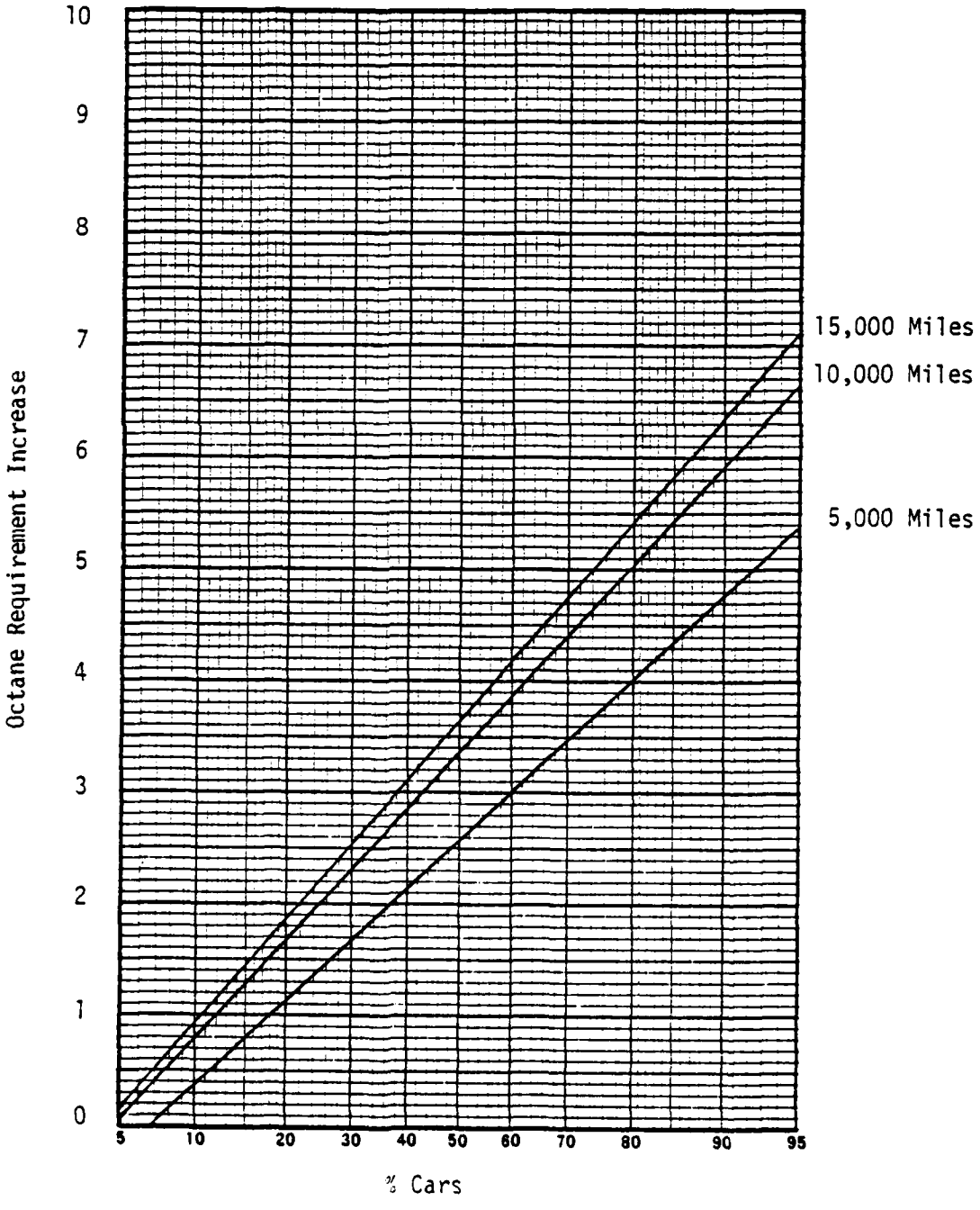


FIGURE 6

DISTRIBUTION OF RON ORI FOR
60 1983 MODEL CARS AT
VARIOUS MILEAGES ON FBRSU FUEL

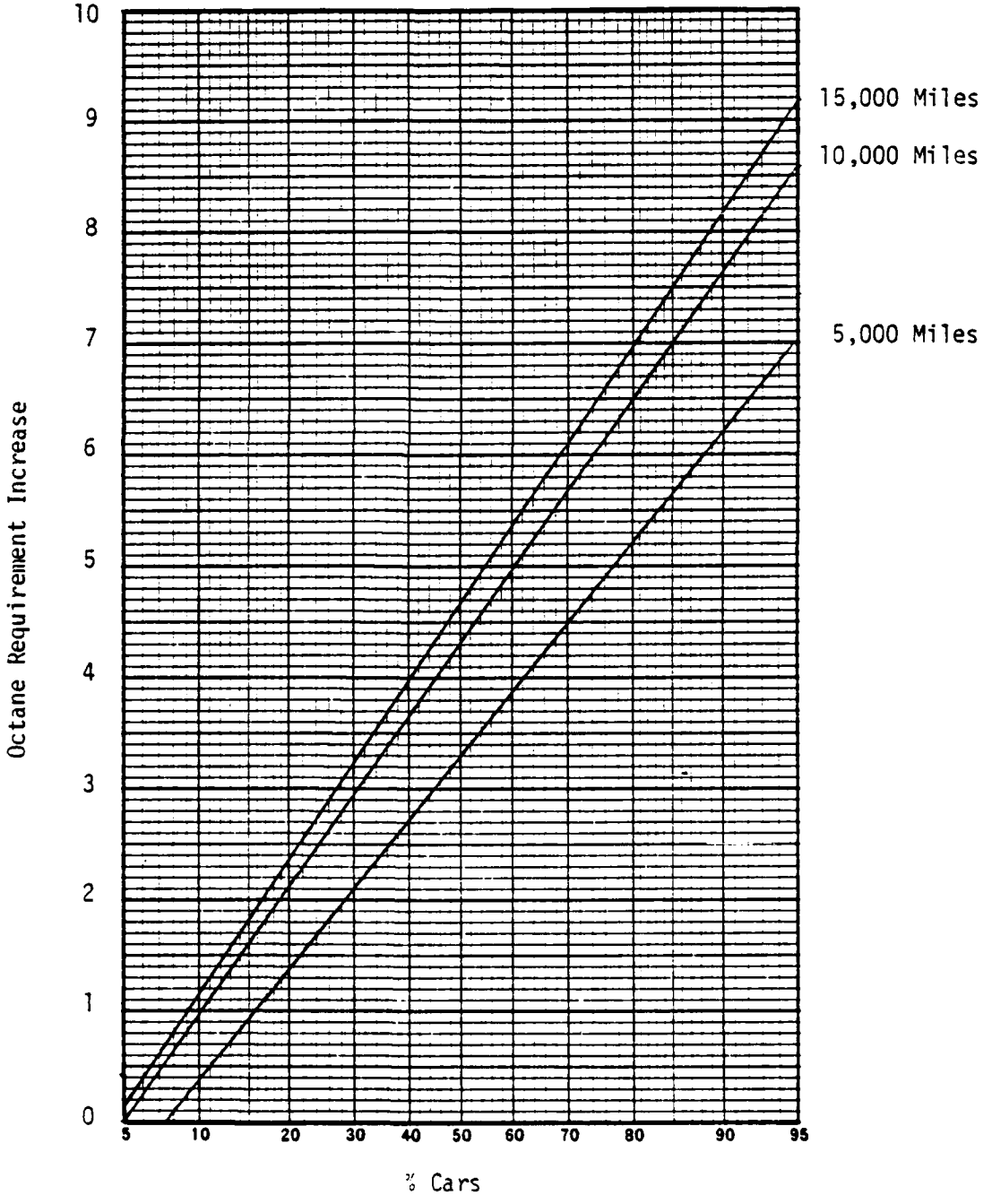


FIGURE 7

DISTRIBUTION OF MON ORI FOR
60 1983 MODEL CARS AT
VARIOUS MILEAGES ON FBRSU FUEL

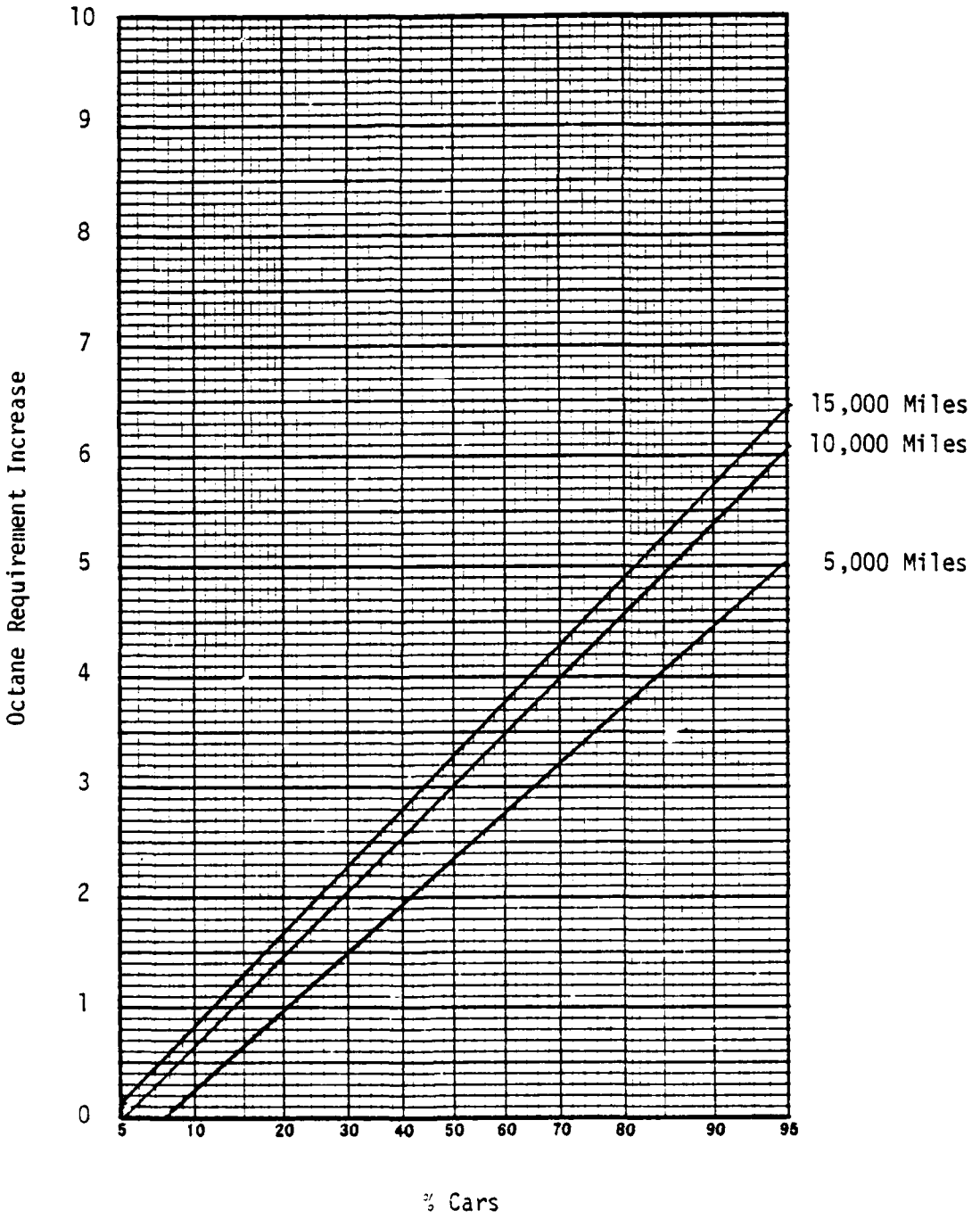


FIGURE 8

DISTRIBUTION OF (R+M)/2 ORI FOR
60 1983 MODEL CARS AT
VARIOUS MILEAGES ON FBRSU FUEL

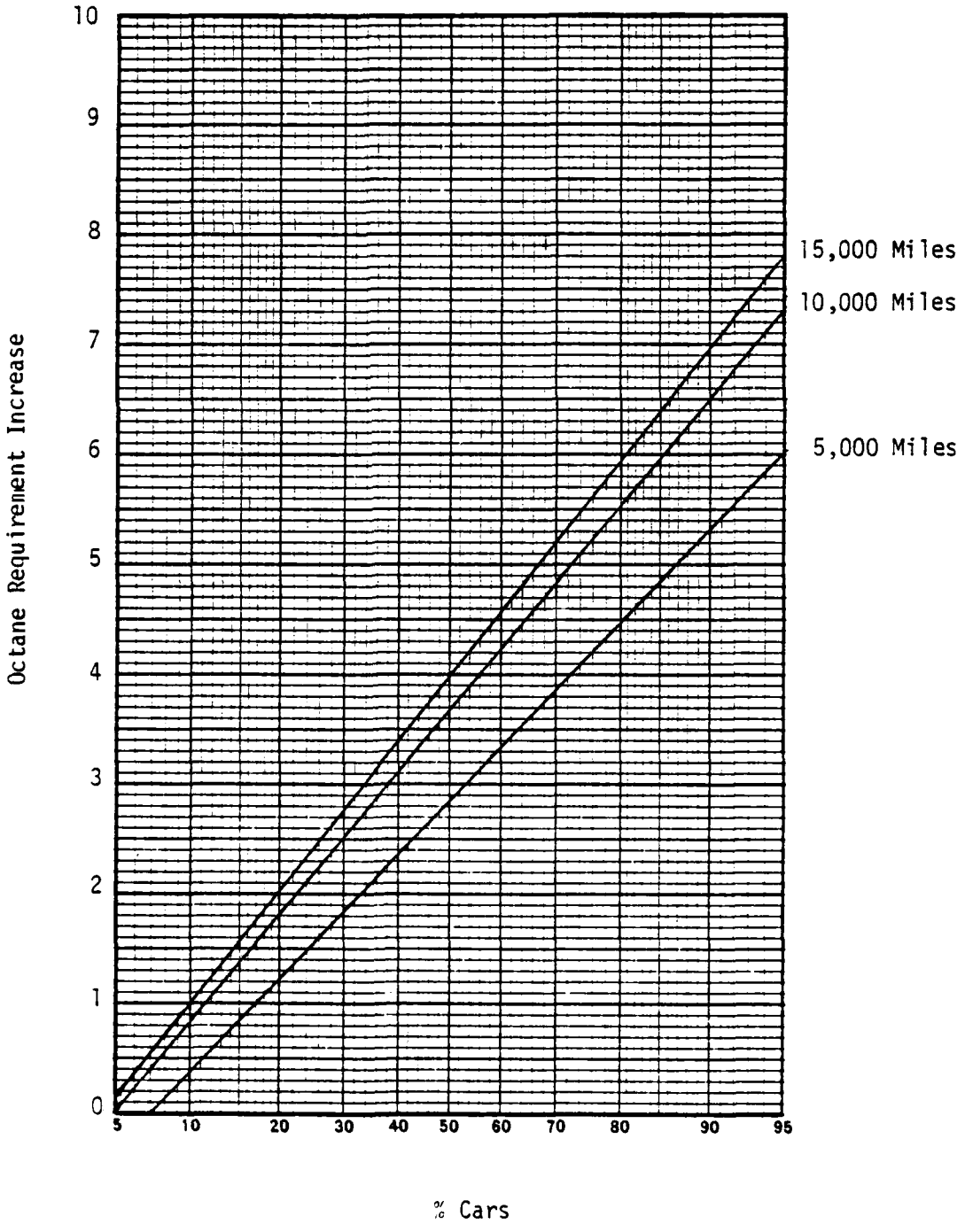


FIGURE 9

DISTRIBUTION OF ORI FOR
60 1983 MODEL CARS AT
VARIOUS MILEAGES ON PR FUEL

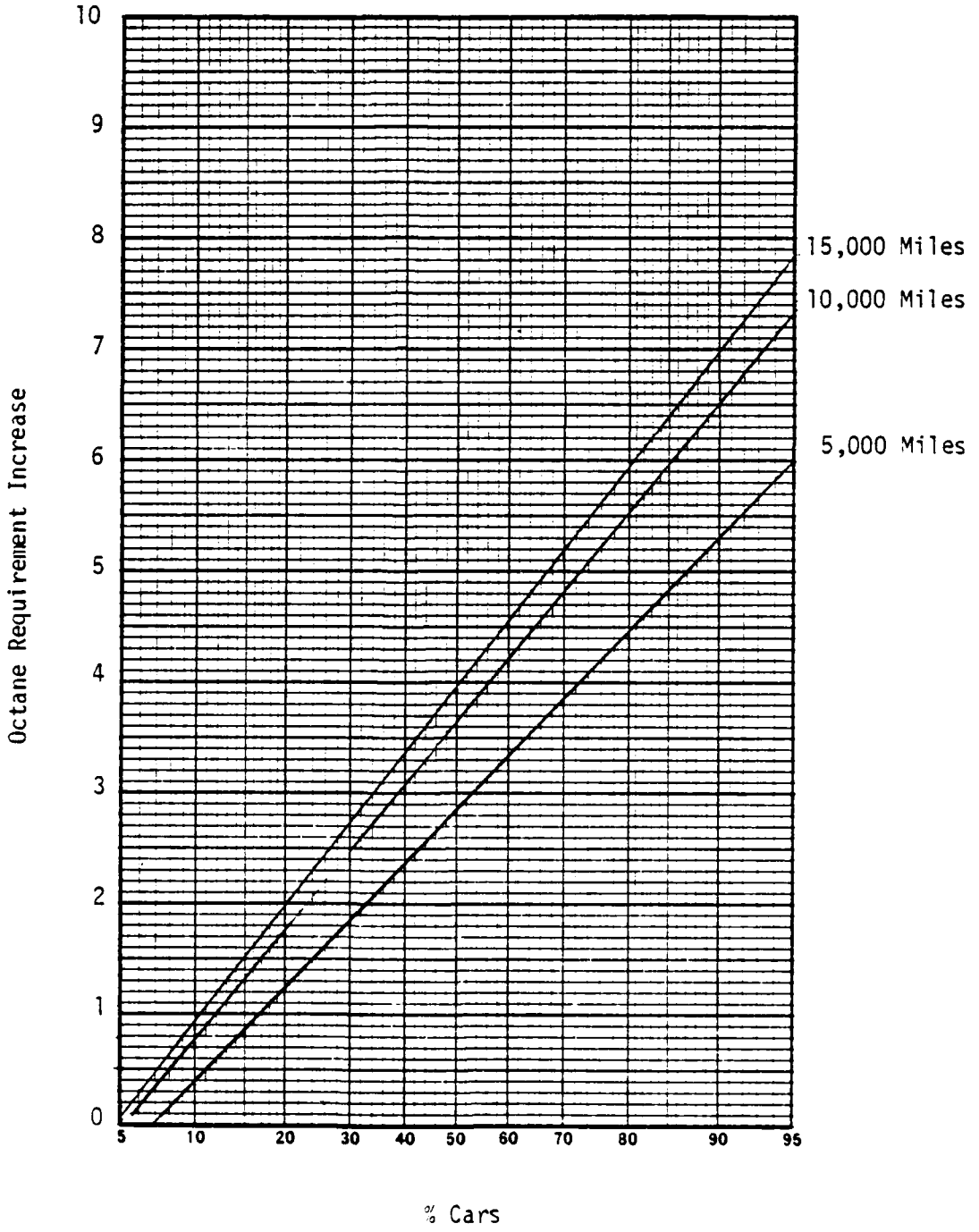


FIGURE 10

MEAN ORI OF 1975 THROUGH 1983 MODEL YEARS

FIBRO IRON

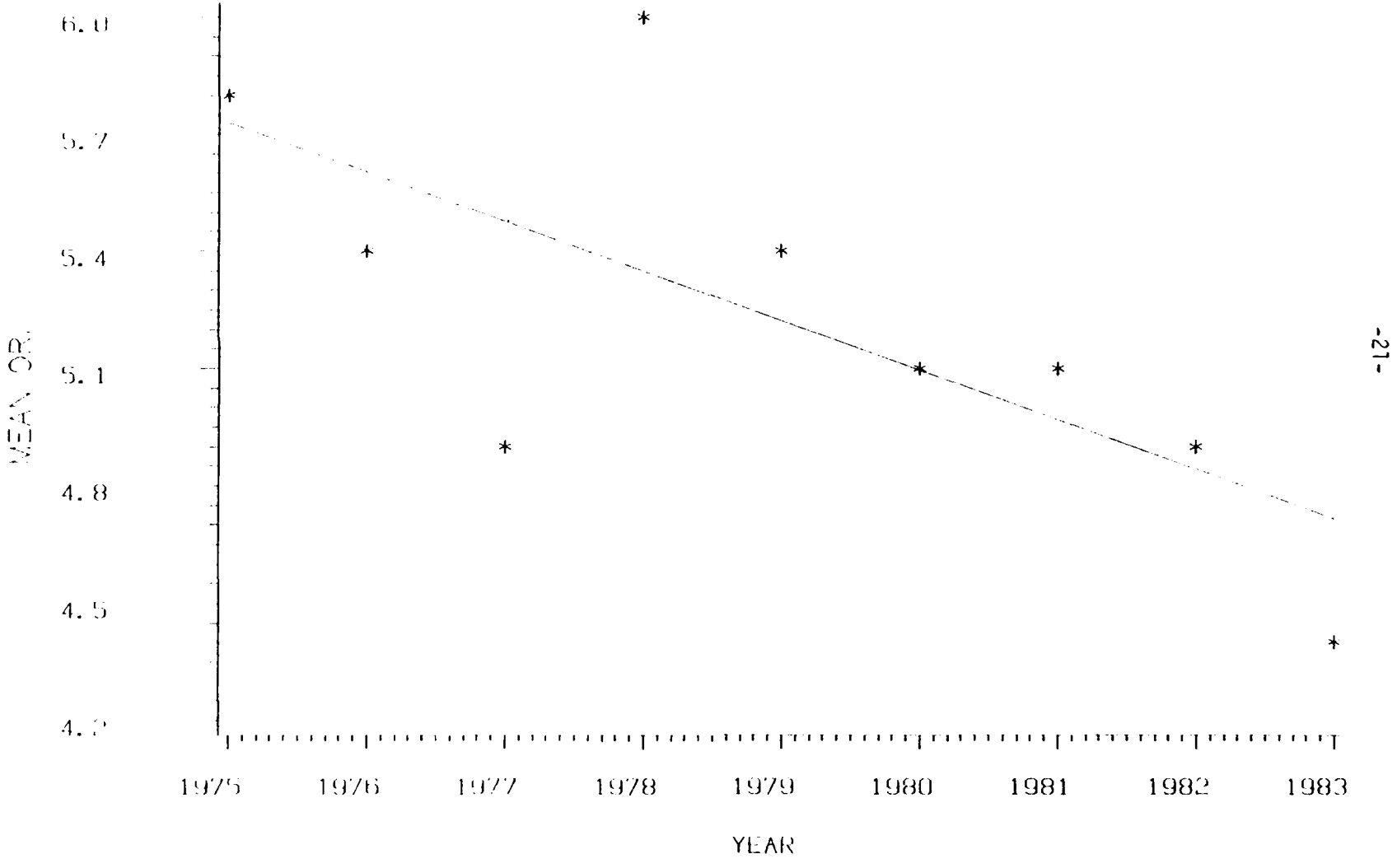


FIGURE 11

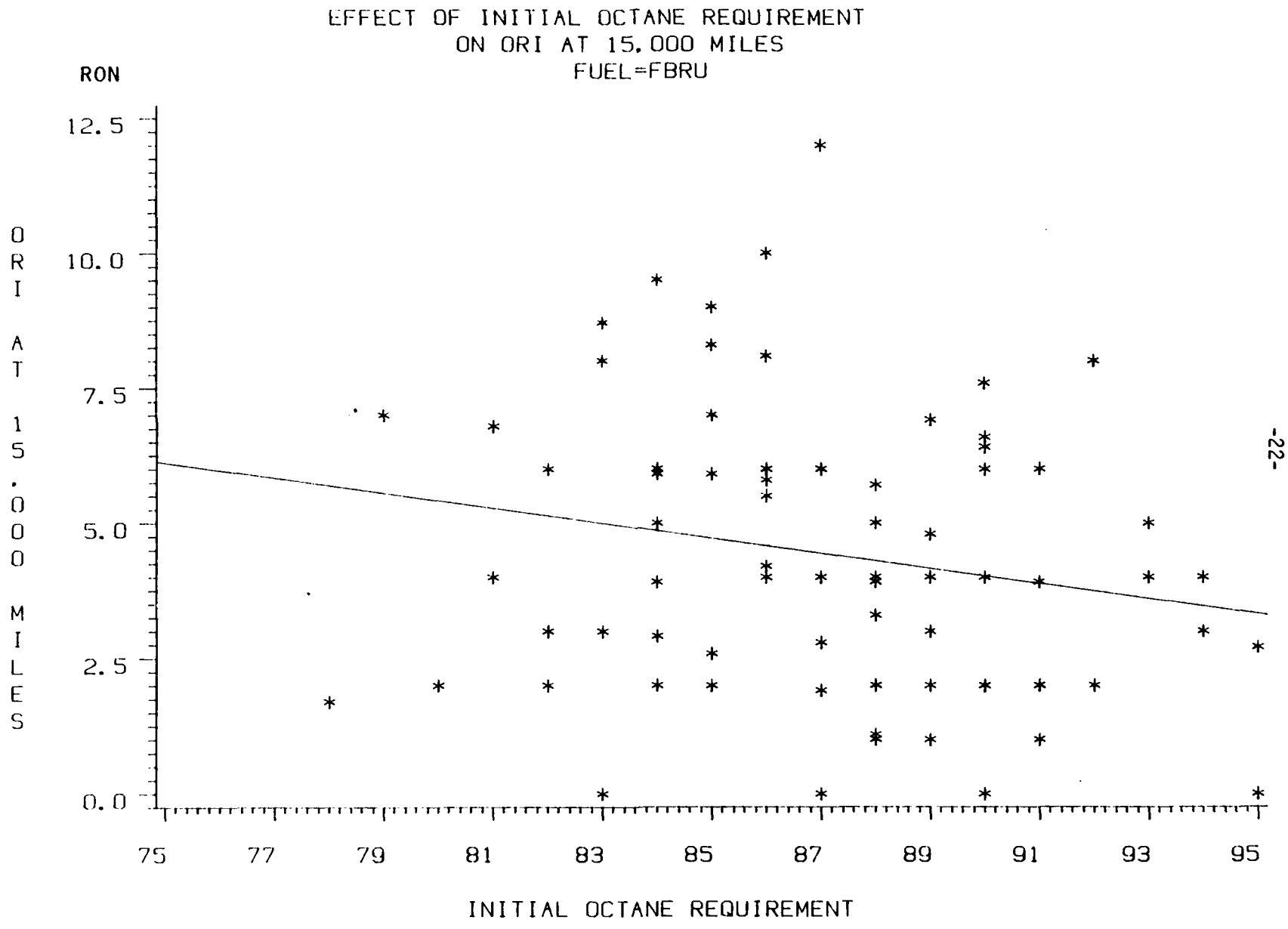

EFFECT OF INITIAL OCTANE REQUIREMENT
ON ORI AT 15,000 MILES
FUEL=FBRU
RON
ORI AT 15,000 MILES
12.5
10.0
7.5
5.0
2.5
0.0
75
77
79
81
83
85
87
89
91
93
95
INITIAL OCTANE REQUIREMENT

FIGURE 12

EFFECT OF INITIAL OCTANE REQUIREMENT
ON ORI AT 15,000 MILES
FUEL=FBRSU

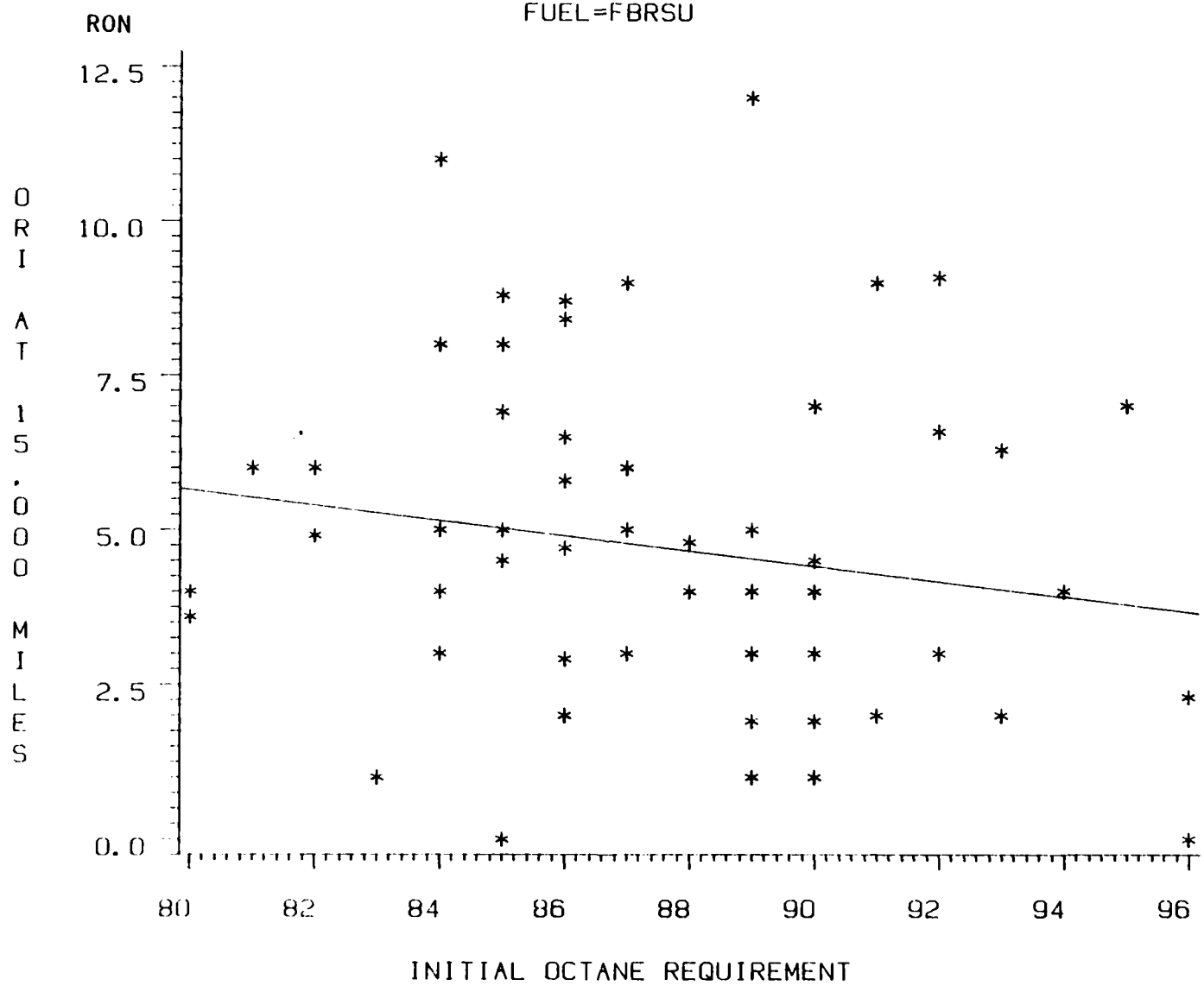
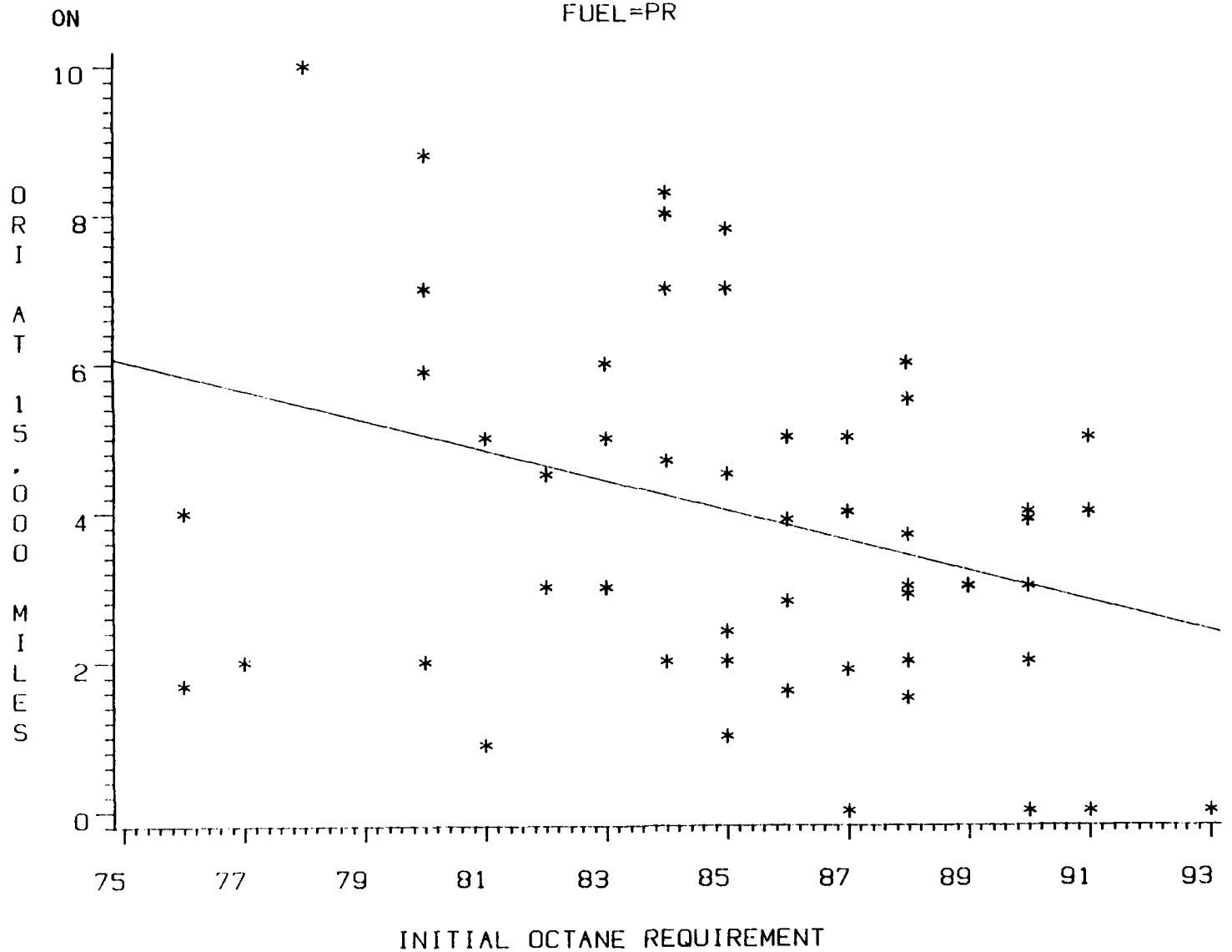


FIGURE 13

EFFECT OF INITIAL OCTANE REQUIREMENT
ON ORI AT 15,000 MILES
FUEL=PR



A P P E N D I X A

LABORATORIES REPORTING OCTANE REQUIREMENT DATA AT VARIOUS MILEAGES

LABORATORIES REPORTING OCTANE REQUIREMENT DATA AT VARIOUS MILEAGES

Amoco Oil Company
Naperville, Illinois

Exxon Research and Engineering Company
Linden, New Jersey

General Motors Research Laboratories
Warren, Michigan

Gulf Research and Development Company
Pittsburgh, Pennsylvania

Shell Development Company
Houston, Texas

Shell Canada
Oakville, Ontario

A P P E N D I X B

MEMBERSHIP:

1983 OCTANE REQUIREMENT INCREASE
DATA ANALYSIS PANEL

1983 OCTANE REQUIREMENT INCREASE

DATA ANALYSIS PANEL

Name	Company
J. C. Callison, Leader	Amoco Oil Company
J. B. Baker	Shell Development Company
R. A. Bouffard	Exxon Research and Engineering Company

APPENDIX C

REFERENCE FUEL DATA

TABLE C-I

AVERAGE SENSITIVITY FULL-BOILING RANGE UNLEADED REFERENCE FUEL SERIES (FBRU)

Research Octane No.	1983 Motor Octane No.	1982 Motor Octane No.	Lab X Motor Octane No.
78.0	74.2	74.0	73.2
80.0	75.8	75.8	74.9
82.0	77.4	77.6	76.6
84.0	78.9	79.2	78.2
85.0	79.6	79.9	79.0
86.0	80.3	80.5	79.7
87.0	80.9	81.1	80.4
88.0	81.6	81.7	81.1
89.0	82.2	82.2	81.8
90.0	82.8	82.8	82.5
91.0	83.5	83.3	83.2
92.0	84.1	83.7	83.9
93.0	84.7	84.2	84.6
94.0	85.4	85.0	85.4
95.0	86.0	85.7	86.2
96.0	86.7	86.4	87.1
97.0	87.3	87.1	87.8
98.0	88.0	87.8	88.5
99.0	88.8	88.5	89.3
100.0	89.5	89.3	90.1
101.0	90.3	90.2	90.8

TABLE C-II

HIGH SENSITIVITY FULL-BOILING RANGE UNLEADED REFERENCE FUEL SERIES (FBRSU)

Research Octane No.	1983 Motor Octane No.	1982 Motor Octane No.
78.0	71.7	71.8
80.0	73.2	73.2
82.0	75.0	74.7
84.0	76.4	76.2
85.0	77.1	76.9
86.0	77.8	77.7
87.0	78.5	78.4
88.0	79.3	79.1
89.0	80.0	79.9
90.0	80.7	80.8
91.0	81.3	81.4
92.0	81.9	82.1
93.0	82.5	82.7
94.0	83.1	83.3
95.0	83.8	83.9
96.0	84.5	84.6
97.0	85.2	85.3
98.0	85.9	86.0
99.0	86.6	86.8
100.0	87.3	87.6
101.0	88.1	88.3
102.0	88.9	89.0

APPENDIX D

OCTANE REQUIREMENT DATA

TABLE D-I

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRU FUEL

CRC Car Code	RON Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
IAE 230	90.0	91.2	91.9	92.0
IAE 230	86.0	92.0	92.0	92.0
LAE 230	86.0	88.6	90.9	92.0
LAE 230	88.0	90.8	92.0	92.0
LC4 441	90.0	94.5	96.4	97.6
LC4 441	88.0	90.3	91.3	91.9
LB4 441	94.0	96.3	96.9	97.0
LXX 228	88.0	90.0	90.0	90.0
HXX 228	90.0	92.4	93.5	94.0
NXX 228	86.0	88.5	89.5	90.0
IJP F20	94.0	96.1	97.6	98.0
HJP F20M	88.0	90.0	90.0	90.0
NJP F20	90.0	94.3	95.6	96.0
NJP F20	92.0	93.8	94.0	94.0
LJO F18	86.0	89.8	91.1	91.8
HJO F18	84.0	90.5	92.5	93.5
HJO F18	84.0	90.0	90.0	90.0
LBA E38	88.0	91.3	92.5	93.0
HJO F18	84.0	87.7	88.7	89.0
LAR 230	85.0	86.8	87.0	87.0
NJP F20	89.0	92.0	92.0	92.0
NAX 230	89.0	92.0	92.8	93.0
NG9 238	87.0	93.0	93.0	93.0
HBH 450	91.0	91.9	92.0	92.0
OA5 F16	89.0	91.4	93.3	93.8
OD3 238	87.0	91.0	91.0	91.0
OFF F50	90.0	91.9	92.0	92.0
J 318	82.0	86.7	87.8	88.0
E 216	89.0	90.3	91.0	91.0
HAR F25	86.0	92.1	96.0	96.0
T 216	87.0	90.9	92.3	93.0
LGA 238	92.0	100.0	100.0	100.0
NJP F20	93.0	95.1	96.7	97.0
NAX 230	87.0	97.0	98.6	99.0
PLC 222	93.0	97.9	98.0	98.0
MEF F50	87.0	90.6	92.1	93.0
J 318 M	86.0	91.0	92.0	92.0
T F28	82.0	83.8	84.0	84.0
NTC 216M	88.0	92.4	94.0	93.7
IAR F25	89.0	94.9	96.0	95.9

TABLE D-I
(Continued)

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRU FUEL

CRC Car Code	RON Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
E 220 M	79.0	86.0	86.0	86.0
IJO F18M	91.0	92.3	93.6	94.9
E 216 M	91.0	93.0	93.0	93.0
OA4 216M	85.0	92.4	93.8	94.0
RA6 F14	84.0	88.9	90.0	90.0
RA6 F14	82.0	84.8	84.9	85.0
RA6 F14M	85.0	86.7	87.3	87.6
NJP F20	90.0	94.2	95.9	96.6
NJP F20M	90.0	93.9	95.7	96.4
T F28	78.0	78.6	79.3	79.7
T F28	81.0	83.7	84.7	85.0
NJP F20M	95.0	96.2	97.1	97.7
HFS F50	91.0	92.2	92.7	93.0
DKC 222	88.0	88.6	88.9	89.1
TF 28	83.0	83.0	83.0	83.0
J 318 M	85.0	90.2	91.8	92.0
RA6 F14	85.0	88.2	91.2	93.3
KKC 222	87.0	87.0	87.0	87.0
OE3 238	89.0	89.7	90.0	90.0
OA4 R16	87.0	88.6	89.3	89.8
OA5 F16	81.0	85.5	87.2	87.8
LGA 238	83.0	89.2	90.8	91.0
LGA 238	83.0	90.1	91.4	91.7
LGA 238	83.0	84.4	85.6	86.0
LAE 230	85.0	87.4	89.5	90.9
LG4 441	84.0	88.1	89.6	89.9
LAE 230	84.0	85.7	86.0	86.0
LXR F25	88.0	88.4	88.8	89.0
NFS F50	90.0	90.0	90.0	90.0
NJP F20	91.0	93.3	95.8	97.0
NTC 216	84.0	86.3	86.9	86.9
OD3 238	95.0	95.0	95.0	95.0
OD3 238	86.0	88.1	89.4	90.2
OD3 238	87.0	88.1	88.4	88.9
LAE 230	88.0	89.6	90.6	91.3
LAE 230	86.0	89.1	90.8	91.5
HJO F18	84.0	86.7	87.7	87.9
HJO F18	80.0	81.9	82.0	82.0
RA6 F14	86.0	90.2	92.8	94.1

TABLE D-II

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRSU FUEL

CRC Car Code	RON Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
LAR 230	86.0	87.8	88.0	88.0
NJP F20	90.0	92.9	93.0	93.0
NAX 230	90.0	93.0	93.8	94.0
NG9 238	89.0	93.9	94.0	94.0
HBH 450	91.0	92.5	93.0	93.0
OA5 F16	90.0	91.8	93.4	94.5
OD3 238	88.0	91.9	92.0	92.0
OFF F50	89.0	91.2	92.0	92.0
J 318	84.0	88.5	89.0	89.0
E 216	89.0	91.0	91.8	92.0
HAR F25	87.0	92.8	95.9	96.0
T 216	89.0	91.4	92.4	93.0
LGA 238	92.0	101.0	101.0	101.1
NJP F20	94.0	96.0	97.7	98.0
NAX 230	89.0	99.0	100.7	101.0
PLC 222	95.0	100.0	101.5	102.0
MEF F50	87.0	90.7	92.1	93.0
J 318 M	87.0	90.1	92.0	92.0
T F28	83.0	84.0	84.0	84.0
NTC 216M	90.0	93.0	93.9	94.0
IAR F25	90.0	96.0	96.9	97.0
E 220 M	81.0	87.0	87.0	87.0
IJO F18M	92.0	93.0	94.0	95.0
E 216 M	89.0	93.0	93.0	93.0
OA4 216M	84.0	93.7	94.8	95.0
RA6 F14	86.0	91.2	92.5	92.5
RA6 F14	84.0	87.8	88.0	88.0
RA6 F14M	85.0	88.8	89.9	90.0
NJP F20	92.0	96.1	97.9	98.6
NJP F20	93.0	96.5	98.2	99.3
T F28	80.0	81.5	82.7	83.6
T F28	82.0	85.4	86.7	86.9
NJP F20M	96.0	97.2	97.8	98.3
HFS F50	93.0	94.3	94.8	95.0
DKC 222	89.0	89.7	89.9	90.0
TF 28	85.0	85.0	85.0	85.0
J 318 M	85.0	91.0	92.7	93.0
RA6 F14	86.0	89.4	92.3	94.4
KKC 222	89.0	89.9	90.6	90.9
OE3 238	90.0	90.5	90.9	91.0

TABLE D-II
(Continued)

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRSU FUEL

CRC Car Code	RON Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
OA4 R16	88.0	91.0	92.3	92.8
OA5 F16	82.0	86.0	87.5	88.0
LGA 238	84.0	90.3	91.8	92.0
LGA 238	85.0	92.5	93.5	93.8
LGA 238	84.0	87.0	87.0	87.0
LAE 230	86.0	88.4	90.5	91.8
LG4 441	85.0	89.1	90.0	91.9
LAE 230	86.0	87.1	87.9	88.0
LXR F25	89.0	89.4	89.8	90.0
NFS F50	90.0	91.0	91.0	91.0
NJP F20	91.0	94.9	98.3	100.0
NTC 216	86.0	87.6	88.4	88.9
OD3 238	96.0	96.0	96.0	96.0
OD3 238	86.0	88.7	90.1	90.7
OD3 238	87.0	88.7	89.6	90.0
LAE 230	90.0	90.8	91.5	91.9
LAE 230	87.0	91.7	92.9	93.0
HJO F18	85.0	87.7	89.1	89.5
HJO F18	80.0	83.8	84.0	84.0
RA6 F14	86.0	91.2	93.6	94.7

TABLE D-III

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - PR FUEL

CRC Car Code	RON Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
LAR 230	85.0	86.0	86.0	86.0
NJP F20	88.0	91.0	91.0	91.0
NAX 230	88.0	89.8	90.0	90.0
NG9 238	87.0	91.0	91.0	91.0
HBH 450	91.0	91.0	91.0	91.0
OA5 F16	88.0	90.0	91.0	91.7
OD3 238	86.0	88.0	89.5	89.9
OFF F50	88.0	90.0	90.7	90.9
J 318	80.0	85.4	86.8	87.0
E 216	90.0	91.4	91.9	92.0
HAR F25	84.0	89.5	92.0	92.0
T 216	86.0	90.9	91.0	91.0
LGA 238	90.0	94.0	94.0	94.0
NJP F20	91.0	93.1	94.7	95.0
NAX 230	87.0	91.0	91.0	91.0
PLC 222	89.0	92.0	92.0	92.0
MEF F50	87.0	90.0	91.2	92.0
J 318 M	85.0	90.0	91.6	92.0
T F28	80.0	82.0	82.0	82.0
NTC 216M	88.0	92.4	93.7	94.0
IAR F25	89.0	92.0	92.0	92.0
E 220 M	80.0	87.0	87.0	87.0
IJO F18M	90.0	91.2	92.5	93.9
E 216 M	89.0	92.0	92.0	92.0
OA4 216M	84.0	91.7	92.0	92.0
RA6 F14	83.0	87.8	88.9	89.0
RA6 F14	82.0	84.2	84.9	85.0
RA6 F14M	86.0	87.0	87.4	87.6
NJP F20	88.0	91.2	92.8	93.5
NJP F20M	89.0	91.8	92.0	92.0
T F28	76.0	76.6	77.2	77.7
T F28	81.0	81.3	81.6	81.9
NJP F20M	91.0	94.4	95.6	96.0
HFS F50	90.0	91.9	92.6	93.0
DKC 222	84.0	86.8	88.2	88.7
TF 28	77.0	78.3	78.7	79.0
J 318 M	84.0	89.0	90.6	91.0
RA6 F14	84.0	87.1	90.1	92.3
KKC 222	83.0	85.0	86.0	86.0
OE3 238	88.0	89.4	90.0	90.0

TABLE D-III
(Continued)

OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - PR FUEL

CRC Car Code	RON Requirements at 0 Miles	5,000 Miles	10,000 Miles	15,000 Miles
OA4 R16	87.0	88.3	88.8	88.9
OA5 F16	81.0	84.4	85.7	86.0
LGA 238	78.0	86.2	87.8	88.0
LGA 238	80.0	86.8	88.4	88.8
LGA 238	80.0	84.0	85.5	85.9
LAE 230	85.0	86.0	86.6	87.0
LG4 441	83.0	87.1	88.0	88.0
LAE 230	83.0	85.5	86.0	86.0
LXR F25	87.0	87.0	87.0	87.0
NFS F50	90.0	90.0	90.0	90.0
NJP F20	88.0	90.4	92.8	94.0
NIC 216	84.0	85.3	85.7	86.0
OD3 238	93.0	93.0	93.0	93.0
OD3 238	85.0	86.1	87.0	87.4
OD3 238	86.0	87.5	88.5	88.8
LAE 230	88.0	88.7	89.3	89.5
LAE 230	85.0	87.5	88.8	89.5
HJO F18	82.0	84.8	86.1	86.5
HJO F18	76.0	79.4	80.0	80.0
RA6 F14	85.0	90.1	91.9	92.8

END

FILMED

2-86

DTIC